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Proficiency Manual

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Proficiency Admissions for the Montana University System

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Preface

Dear Students and Teachers:

Over the past few years, the Office of Public Instruction and the Commissioner of Higher Education's Office have appointed teams of mathematics teachers and professors to explore ways to improve all Montana students' transition from high school to higher education. The work of these committees contributed to the K-12 Mathematics Content Standards. These standards were adopted and are followed now. The committees also assembled information that shows mathematics proficiency levels necessary for satisfactory performance in specific math courses and specific college majors, and explored current and potential uses of several standardized tests.

To reduce the need for remediation and increase a student's success in college, the Montana Board of Regents challenged these committees to establish levels of mathematics proficiency for entry into the post-secondary educational environment. This manual supports the commitment to our students after graduation from high school, whether it is in a vocational setting of higher learning or a university system.

This manual is the result of so many educators who share a commitment to excellence and high expectations for themselves and their students. It is designed to provide clear information to high school students, their parents, and high school teachers about the skills necessary to be considered proficient in mathematics. We commend the members of the Mathematics Steering Committee for developing this manual. These members exemplify so many educators in the state of Montana who wake up every day committed to seeing their students succeed. We thank them and hope this manual is of assistance to you.

Sincerely,

Linda McCulloch
Superintendent of Public Instruction

Dr. Richard Crofts
Commissioner of Higher Education

February 2002

This *Student Mathematics Proficiency Manual* was developed by a team representing the Office of the Commissioner of Higher Education, the Montana Office of Public Instruction, and the Mathematics Proficiency Steering Committee listed on page six. It was reviewed by, and includes recommendations from an Advisory Committee representing every unit of the Montana University System, tribal colleges, the Board of Public Education, and ten mathematics teachers from middle and high schools throughout Montana.

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Student Mathematics Proficiency Manual

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Introduction

In 1995, the Montana Board of Regents approved a policy entitled "Proficiency Admission Requirements and Developmental Education in the Montana University System," which required that the system "adopt a uniform assessment tool to be used in determining if students or prospective students have the basic proficiencies in math and English to provide them a reasonable chance of success in postsecondary education." (See Appendix One.)

In 1997, Superintendent of Public Instruction, Nancy Keenan, and Commissioner of Higher Education, Richard Crofts, appointed a Joint Committee on K-16 Mathematics Standards to establish levels of math proficiency for entry into post-secondary education. That committee contributed to the K-12 Mathematics Content Standards, began developing common identifiers and descriptors for mathematics courses tied to K-12 Performance Standards, and explored current and potential uses of several standardized tests. The K-16 Mathematics Committee formed a Steering Committee to develop supporting materials and draft a recommendation for the Board of Regents. This document is a product of that Steering Committee, whose members are listed on the following page.

The mathematics committees are working concurrently with writing committees. A Joint K-16 Committee in Writing made recommendations to the Board of Regents and formed a smaller Writing Proficiency Steering Committee. In July 2000, the Montana Board of Regents moved to begin implementing proficiency-based admissions standards in writing for the Montana University System to become operational in Fall 2004. The proposed measures for assessing proficiency in writing include the ACT Writing Sample, an Advanced Placement Examination in English, and the College Level Examination Program (CLEP) Freshmen Composition test. Volunteer high schools are field-testing a Montana version of the ACT Writing Sample in the Springs of 2001, 2002 and 2003.

The work of these K-16 volunteer committees in writing and mathematics echoes goals of the National Association for Developmental Education. A seamless education program will:

- preserve and make possible educational opportunity for each postsecondary learner;
- develop in each learner the skills and attitudes necessary for the attainment of academic career and life goals;
- ensure proper placement by assessing each learner's level of preparedness for college course work;
- maintain academic standards by enabling learners to acquire competencies needed for success in mainstream college courses; and

- promote the continued development and application of cognitive and affective learning theory.

Members of the Mathematics Proficiency Steering Committee listed below encourage teachers, students, and community members to communicate with them in order to help students qualify for Proficiency Admissions.

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Alignment of MUS Admission Requirements with K-12 Mathematics Standards

The Montana Board of Public Education adopted new content standards for Montana's K-12 schools in 1999-2000. According to the Montana Standards for Mathematics, "High school mathematics gives students the ability to solve problems, communicate ideas and strategies, and apply skills in other disciplines. Students are expected to understand and investigate mathematical concepts, use mathematics in real-world situations, and select and use appropriate technology to model and study mathematical processes. Upon graduation, students should be able to apply mathematical processes correctly to solve a variety of problems."

To go on to higher education, students should have become proficient in the use of:

- Numbers and Operations;
- Algebraic concepts;
- Geometry;
- Measurement processes;
- Data analysis, probability, and statistics; and
- Patterns, relations, and functions.

In Montana's Performance Standards, Proficient performance is described in this way: A graduating student at the proficient level in mathematics demonstrates solid academic performance. He/she:

(a) consistently applies mathematical processes correctly to solve a variety of problems and communicate the results;

(b) applies mathematics in a variety of contexts;

(c) consistently uses appropriate technology to apply functions, graphs, and algebraic concepts to solve real and theoretical problems;

(d) uses complex reasoning to formulate logical arguments and proofs using appropriate mathematical ideas;

(e) consistently applies complex measurement and geometric and algebraic relationships to model a variety of problems and situations;

(f) makes reasonable predictions and decisions based on data, probability and statistics; and

(g) recognizes interconnections within and outside mathematics.

The complete text of Content and Performance Standards can be found at the OPI web address: www.opi.state.mt.us.

In most schools, these skills are taught in the courses listed for Montana's college admissions standards described on the next page (Algebra I, Geometry, and Algebra II.). (recent studies have shown that college readiness can be improved by taking four years of mathematics, including an advanced math (such as pre-calculus or statistics) in the senior year *(Selected Trends on ACT-Tested Students; ACT Research Division,* Iowa City).

The pages labeled "Seamless Entrance Standards for Mathematics" in this publication further ensure an alignment of high school and college standards, showing how the designated levels of Advanced, Proficient, Nearing Proficiency, and Novice described in the K-12 Performance Standards correspond to college entrance exams. They also suggest appropriate coursework and possible college majors for students at each level of performance.

Montana University System College Admissions Requirements

Regents' College Preparatory Curriculum

The Montana Board of Regents recommends a minimum program of high school study as a good preparation for college-level work. In order to satisfy the Regents' College Preparatory Core and be admitted to most campuses of the Montana University System, students must complete:

a. Four years of English: In each year, the content of the courses should emphasize the development of written and oral communication skills and literature.

b. Three years of mathematics which shall include Algebra I, Geometry and Algebra II (or the sequential content equivalent of these courses). Students are encouraged to take a math course in their senior year.

c. Three years of social studies which shall include global studies (such as World History or World Geography); American History; and Government, Economics, Indian History or other third-year courses.

d. Two years of laboratory science: one year must be Earth Science, Biology, Chemistry, or Physics; the other year can be one of those sciences or another approved college preparatory laboratory science.

e. Two years chosen from the following:

- foreign language (preferably two years)
- computer science
- visual and performing arts, or
- vocational education units that meet the Office of Public Instruction's guidelines.

Additional Admissions Requirements Currently in Rule

In addition to the above College Preparatory Program, to enter any four-year campus, a high school graduate must meet at least one of the following requirements:

a. (1) has obtained a score of at least 20 on the Enhanced (Composite) American College Testing (ACT) test or a score of at least 960 on the total ver-

bal/math exam of the Scholastic Aptitude Test (SAT), for admission to Montana State University-Northern and Western Montana College of The University of Montana;

(2) has obtained a score of at least 22 on the Enhanced (Composite) American College Testing (ACT) test or a score of at least 1030 on the total verbal/math exam of the Scholastic Aptitude Test (SAT), for admission to Montana State University-Billings, Montana Tech of The University of Montana, Montana State University-Bozeman, and The University of Montana-Missoula. The campuses identified in 1.a.(1) above may request permission from the Board of Regents to raise the Enhanced (Composite) American College Testing (ACT) test score or the Scholastic Aptitude Test (SAT) total verbal/math exam score to those specified for The University of Montana-Missoula, Montana State University-Bozeman, Montana State University-Billings, and Montana Tech of The University of Montana; or

b. has obtained at least a 2.5 high school grade point average (GPA); or

c. ranks in the upper half of the school's graduating class.

Note: Certain exceptions are also described in the policy.

Additional Admissions Requirements Under Consideration

In 2002, mathematics teachers and professors, the Office of the Commissioner of Higher Education, the Office of Public Instruction, and education's governing bodies began considering setting admissions standards for mathematics in addition to the requirements listed on the previous page. These standards may go into effect slowly, so that teachers and students will be adequately prepared. In addition, some campuses within the Montana University System may adopt program-specific standards to reflect the necessary level of mathematics preparation for successful entry into those programs.

The Mathematics Proficiency Steering Committee will recommend that admissions standards be based on a student's mathematics score on an ACT, SAT, or AP test. These tests are available to students and have been used by many institutions to assist with college admissions decisions.

As of this printing, the Montana Board of Regents has not yet established a method of determining proficiency or decided upon test scores in mathematics for admissions. However, students should prepare for the future possibility that they must have a minimum mathematics test score in order to be admitted to one of the four-year campuses of the Montana University System.

If the Board adopts recommendations from the mathematics committees, some of the campuses may require that students need to earn minimum mathematics scores on tests such as the ACT or the SAT. Then, these minimum scores may be raised by one point for the year 2005 and raised again in 2006. For example, at some time in the future, students may be required to earn a minimum mathematics score of 18 on the ACT or 440 on the SAT. In order to set minimum scores, advisors research the number of students currently testing at each score point, the requirements of a typical college mathematics course, and how well students perform in college in relation to their test scores.

Currently, the mathematics committees recommend that open admissions remain in place for the Colleges of Technology, Community Colleges, and Tribal Colleges. However, these two-year colleges are developing strategies to allow students to demonstrate their competencies should they transfer into four-year programs.

By setting admissions standards in mathematics and writing, the Montana University System hopes to ensure that students know what level of skills they must develop in order to be successful in college. These standards should increase the level of mathematics instruction in the high schools and colleges of Montana.

Rationale for using ACT or SAT scores for Admissions

Research shows higher ACT scores and completion of recommended core coursework is closely associated with higher college graduation/persistence rates. Course-taking patterns are also very important. ACT recommends that students take four years of mathematics in high school for a solid college-preparatory core. ACT-tested college freshmen who report better academic preparation in high school earn higher ACT scores, earn better grades in college, tend to persist at higher rates, and graduate at higher rates than those who had less than core coursework. Data also indicate that students with higher ACT scores have higher high school averages and higher college freshmen GPAs (Maxey, J. 2001, *Selected Trends on ACT-Tested Students*).

Aligning ACT Mathematics Scores with Freshman Courses and Majors

To help students succeed in the Montana University System, tests such as the ACT, SAT, ASSET, and Compass are currently used to place students in the mathematics courses that most nearly match their skills. This table shows how ACT test scores are used to suggest placement.

Average ACT Math Score	Suggested Course	Required for Major of:
≥27 Advanced II	Calculus	Chemistry Math Engineering Physics Computer Science
25-26 Advanced I	Pre-Calculus Finite Math Statistics Trigonometry	Engineering Tech Business Biology Forestry Pharmacy
21-24 Proficient	College Algebra Contemporary Math Math for Teachers	General Education Human Services Education Business Communications
16-20 Nearing Proficiency	Intermediate Algebra	Automotive Building Trades Practical Nursing
≤15 Novice	Beginning Algebra Developmental Math	Does not count toward major

Standards for Transition for the ACT Mathematics Tests

Because course content varies from school to school, descriptions of competencies may help students and teachers predict how well they may score on standardized tests. The following descriptions, developed by ACT, provide yet another method for analyzing the mathematical skills needed to succeed in college.

The statements below describe what students who score in the specified score ranges are likely to know and to be able to do.

ACT Mathematics Score Range 16-19

Students can solve routine one-step and two-step arithmetic problems, single-step percent problems, and straightforward average problems; recognize one-digit factors of a number; and identify a digit's place value. In probability, statistics, and data analysis, these students can perform computations on data from tables and graphs and determine the probability of the complement of an event. In algebra, they can combine two like terms (e.g., $2x + 5x$); substitute whole numbers for unknown quantities to evaluate expressions; and solve one-step equations having whole number or decimal answers. In coordinate geometry, they can locate points on the number line and in the first quadrant of the coordinate plane. In geometry, they can compute the perimeter of polygons when all side lengths are given and compute the area of rectangles when whole number dimensions are given.

ACT Mathematics Score Range 20-23

Students can solve routine two-step and three-step arithmetic problems, such as rate and proportion problems, multi-step percent problems (e.g., tax added and percentage off), and average problems (e.g., computing with negative integers or using a given average); and exhibit knowledge of elementary number concepts including the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor. In probability, statistics, and data analysis, these students can translate from one representation of data to another (e.g., a bar graph to a circle graph); can determine the probability of a simple event; and exhibit knowledge of simple counting techniques. In algebra, they can manipulate basic algebraic expressions (e.g., substitute integers for unknown quantities, add and subtract simple algebraic expressions, multiply two binomials, and perform straightforward word-to-symbol translations); and solve most first-degree equations. In coordinate geometry, they comprehend the concept of length on the number line; can locate points in the coordinate plane; exhibit knowledge of vertical and horizontal lines and of their point of intersection; and exhibit knowledge of slope. In geometry, they exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 180°

and 360°); can compute the area and perimeter of triangles and rectangles when the problems are simple; and can use geometric formulas when all necessary information is given.

ACT Mathematics Score Range 24-27

Students can solve multi-step arithmetic problems that involve planning or converting units of measure (e.g., feet per second to miles per hour) and work problems involving positive integer exponents, ordering fractions, and numerical factors. In probability, statistics, and data analysis, these students can manipulate data; use Venn diagrams in counting; and compute straightforward probabilities for common situations. In algebra, they can work with square and cube roots; determine when an expression is undefined; square numbers and expressions; factor simple quadratics (e.g., the difference of squares and perfect square trinomials); identify zeros or roots of simple quadratic equations; add, subtract, and multiply polynomials; write expressions or equations with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions); solve real-world problems using first-degree equations; and solve first-degree inequalities that do not require reversing the inequality sign. In coordinate geometry, they can identify the graph of a linear inequality and find the midpoint of a line segment on the number line; and in the coordinate plane, they can determine the slope of a line from points or equations; match linear graphs with their equations; and find the midpoint of a line segment. In geometry, they can use properties of isosceles triangles; recognize Pythagorean triples; use several angle properties to find an unknown angle measure; compute areas and circumferences of circles after identifying necessary information; compute areas of rectangles and triangles when an additional step is required; and compute the perimeter of simple composite geometric figures with unknown side lengths. Additionally, students (ACT Assessment only) can identify a particular trigonometric ratio when all necessary side lengths of a right triangle are given, as well as exhibit knowledge of the complex number *i*.

ACT Mathematics Score Range 28-32

Students can solve word problems containing several rates, proportions, or percentages. In probability, statistics, and data analysis, students can interpret and use information from tables and graphs including graphs in the coordinate plane; apply counting techniques; and apply the definition of probability. In algebra, they can apply the rules of exponents and number properties—often in a new context—to solve problems that involve even/odd numbers, positive/negative integers, and prime factorizations; manipulate equations; write expressions for common algebra settings; solve absolute value equations; solve linear inequalities that require reversing the inequality sign; and find solutions to systems of linear equations. In coordinate geometry, they can graph the solution set of linear inequalities on the number line; and in the coordinate plane, they can use the distance formula and use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point. In geometry, they can apply properties of 30° — 60° — 90°, 45° — 45° — 90°, similar and congruent triangles; use the Pythagorean theorem; and use relationships involving area, perimeter, and volume of geometric figures

to compute another measure. Additionally, students (ACT Assessment only) can recognize special characteristics of parabolas and circles from their equations (e.g., the vertex of a parabola and the center or radius of a circle) and can apply basic trigonometric ratios to solve right-triangle problems.

ACT Mathematics Score Range 33-36

Students can solve complex arithmetic problems involving percent of increase or decrease and problems requiring integration of several concepts from pre-algebra and/or pre-geometry (e.g., comparing percentages or averages, using several ratios, and finding ratios in geometry settings). In probability, statistics, and data analysis, students can analyze and draw conclusions based on information from tables and graphs including graphs in the coordinate plane and exhibit knowledge of conditional and joint probability. In algebra, they can draw conclusions based on number concepts, algebraic properties, and/or manipulating to accurately model a situation; and can solve simple absolute value inequalities. In coordinate geometry, they can graph solutions to simple quadratic inequalities on the number line and identify characteristics of graphs in the coordinate plane based on a general equation such as $y = a x^2 + c$ or on a set of conditions. In geometry, they can draw conclusions based on a set of conditions; solve multi-step geometry problems that involve integrating concepts, planning, visualization, and/or making connections with other content areas (e.g., illustrating a scenario and then determining a solution path, and using algebraic representations for area); use scale factors to determine the magnitude of a size change; and compute the area of irregularly shaped regions that require planning or visualization. In trigonometry, they can use trigonometric concepts and basic identities to solve problems; exhibit knowledge of unit circle trigonometry; and can recognize graphs of basic trigonometric functions.

Seamless Entrance Standards

"Seamless Entrance Standards" show the mathematics proficiency levels necessary for satisfactory performance in specific math courses and specific college majors. These charts were designed to ensure the alignment between the college preparatory core required by the Montana University System and the content standards adopted by the Board of Education. These charts show how the designated levels of Advanced, Proficient, Nearing Proficiency, and Novice described in the K-12 Performance Standards correspond to test scores.

How to Use These Charts

On each of the following pages is a chart showing courses offered to freshmen at each of the units of the Montana University System, as well as community and tribal colleges. In the far left column are performance levels as described by Montana's K-12 Content Standards. High schools may report scores on their own tests in terms of these levels.

The two narrow columns in the middle show the screening devices currently used by each campus to place students into their freshman math class. Some schools set cutoff scores on tests, some set prerequisites, and some use neither.

Each campus also suggests college majors that students typically select if they are correctly placed into the mathematics courses listed in the second column.

High school math teachers and counselors should complete the final column for their own schools by investigating these questions for each of the five rows on the charts:

- For which of our high school courses would a student earn a C or better in order to score on the ACT (or another test with a comparable score) at the score point listed in this row (such as "Proficient")?
- For which of our high school courses would a student earn a C or better in order to be prepared to do well in the college course listed in this row (such as "Proficient")?

The mathematics problems in the last section of this manual were designed to help students understand what kinds of mathematics topics a student at the proficient level should be able to master. These problems further define skills needed for college success and provide specific examples that help complete the *Seamless Entrance Standards* chart.

Charts from Schools

1. **Universities that currently require a score of at least 22 on the Enhanced (composite) ACT or 1030 on the total verbal/mathematics exam of the SAT**

   (See pages 19 to 22)

   - MSU - Bozeman
   - MSU - Billings
   - U of M - Missoula
   - MT Tech of U of M - Butte

2. **Colleges that currently require a score of at least 20 on the Enhanced (composite) ACT or 960 on the total verbal/mathematics exam of the SAT**

   (Pages 23 to 24)

   - MSU - Northern
   - U of M - Western

3. **Colleges that currently have open admissions**

   Colleges of Technology

   (Pages 25 to 28)

   - Billings
   - Butte
   - Great Falls
   - Helena

   Community Colleges

   (Pages 29 to 31)

   - Dawson Community College
   - Flathead Valley Community College
   - Miles Community College

   Tribal Colleges

   (Pages 32 to 38)

   - Blackfeet Community College
   - Chief Dull Knife College
   - Fort Belknap College
   - Fort Peck Community College
   - Little Big Horn College
   - Salish Kootenai College
   - Stone Child College

Montana State University - Bozeman

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level ACT	Screening device/level SAT	College Majors	High School Preparatory Courses
Advanced **Advanced Level II**	Calculus and Analytic Geometry I, Math181, 4 cr. Calculus for Technology, Math 175, 3 cr.	≥27	610	Engineering, Math, Pre-Med, Physics, Chemistry, Biology, Earth Sciences, Computer Science, Economics	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Pre-Calculus, Math 160, 4 cr. Survey of Calculus, Math 170, 4 cr Elementary Statistics, Stat 216, 3 cr.	25-26	570	Architecture, Nursing, Business, Psychology, Range Science, Land Resource Science, Bio-Chem	Four years of college-prep math
Proficient **Proficient**	Math for Elementary Teachers, Math 130, 4 cr. Liberal Arts Math, Math 150, 3 cr. Algebra for College Students, Math 105, 3 cr. Language for Mathematics, Math 151, 3 cr.	23-24	530	Education, Crop Science Core Requirements	Three years of college-prep math
Nearing Proficient **Basic**	Introductory Algebra, Math 103, 3 cr.	21-22	490		Two years of college-prep math
Novice **Remedial**	Pre-Algebra, Math 085				Pre-high school

**See K-12 Mathematics Performance Standards*

All students must meet prerequisites in order to take 100 level mathematics classes at MSU-Bozeman. Prerequisites can be met with the given ACT/SAT scores or with equivalent scores on the MSU-Bozeman Mathematics Placement Test.

Montana State University - Billings

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level ACT	Screening device/level SAT	College Majors	High School Preparatory Courses
Advanced **Advanced Level II**	Calculus I, Math 112, 4 cr.	≥26	600	Chemistry, Math	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Pre-Calculus, Math 107, 5 cr. Finite Math, Math 121, 4 cr. Statistics, Stat 241, 4 cr. Math for Elem. Ed. II, Math 202	22-25	520-580	Pre-Engineering Tech, Business, Biology	Four years of college-prep math
Proficient **Proficient**	College Algebra, Math 106, 3 cr. Math for Elem. Ed. I, Math 201, 3 cr. Intro. to Statistics, Stat 141, 3 cr. Contemporary Math, Math 141, 3 cr.	22-24	520-560	Human Services, Education, Health/PE, General Ed. Core	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 105, 4 cr.	15-21	360-520		Two years of college-prep math
Novice **Remedial**	See MSU-B College of Technology				Pre-high school

**See K-12 Mathematics Performance Standards*

Class placement will be by a mathematics placement instrument. The ACT/SAT and high school record are used as admissions items only. The current placement test used is the ACT Compass Placement Test.

The University of Montana - Missoula

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level ACT	Screening device/level SAT	College Majors	High School Preparatory Courses
Advanced **Advanced Level II**	Applied Calculus, Math 150, 4 cr. Calculus I, Math 152, 4 cr.	†	†	Mathematics, Computer Sciences, Physics/ Chemistry/Biology	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Pre-Calculus, Math 121, 4 cr.	25	570	Biology/Wildlife Biology, Forestry, Pharmacy	Four years of college-prep math
Proficient **Proficient**	Contemporary Mathematics, Math 107, 3 cr. Probability and Linear Math, Math 117, 3 cr. Math for Elementary Teachers, Math 130, 5 cr.	23	530	Minimum graduation requirement for all majors	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 100, 5 cr.	21	490		Two years of college-prep math
Novice **Remedial**	See UM-College of Technology				Pre-high school

**See K-12 Mathematics Performance Standards*

The University of Montana - Missoula encourages all students to take a modified version of the placement test written by the Mathematical Association of America.

†Students are required to take the Calculus Readiness Test for placement into Advanced Level II courses.

Montana Tech of The University of Montana - Butte

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level		College Majors	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	Calculus I, Math 152, Math for Business and Social Sciences, Math 118, Calculus I with Algebra Enhancement, 151	≥24	560	Engineering Science, Chemistry, Mining Eng. Math, Geophysics	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	College Trigonometry, Math 106, Elementary Statistics, Math 132, Math for Business & Social Sciences, Math 117	21-23	500-540	Business, Biology OSH/IH	Four years of college-prep math
Proficient **Proficient**	College Algebra, Math 105	20-23	480-540	Liberal Studies PTC	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 102	< 20	480		Two years of college-prep math
Novice **Remedial**					Pre-high school

**See K-12 Mathematics Performance Standards*

Students will be placed in the appropriate Math course according to their ACT or SAT Math score. Students without ACT and SAT scores will be required to take a placement exam.

Montana State University - Northern - Havre

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level ACT	Screening device/level SAT	College Majors	High School Preparatory Courses
Advanced **Advanced Level II**	Calculus and Analytic Geometry I, Math 220, 5 cr.	27	610	Engineering Tech	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Precalculus, Math 130, 5 cr. Trigonometry, Math 125, 2 cr. Intro to Calculus, Math 133, 3 cr. Probability & Statistics, Math 140, 1 cr.	25-26	580-600	Engineering Tech (Civil), Mathematics, Biology, Design Drafting, Gen. Science, Water Quality/ Environmental Health, Engineering Tech	Four years of college-prep math
Proficient **Proficient**	College Algebra, Math 112, 3 cr.	23-24	540-560	Business, Design Drafting, Engineering Tech, Gen. Science, Water Quality/ Environmental Health, Railroad Maintenance & Operations	Three years of college-prep math
	Mathematics for Elementary Teachers, Math 120, 3 cr. Mathematics for Liberal Arts, Math 110, 4 cr.	20-22	480-520	Elementary Education Communication, Community Service, English, Graphic Design, Health & PE, Liberal Studies, History, Applied Tech, Agricultural Mech Tech, Automotive Tech, Diesel Tech, Computer Info Systems, Metals Tech Biology, Nursing, Water Quality/Environmental Health, Applied Science	
Nearing Proficient **Basic**	Developmental Mathematics II, Math 095, 3 cr.	20-22	480-520		Two years of college-prep math
Novice **Remedial**	Developmental Mathematics I, Math 094, 3 cr.	13-19	310-460		Pre-high school

**See K-12 Mathematics Performance Standards*

In the absence of an ACT/SAT Score, placement will be accomplished by the Compass Placement Instrument.

University of Montana - Western - Dillon

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Screening device/level		College Majors	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	MATH 152 Calculus & Analytic Geometry	> 25	> 580	Math/Science	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	MATH 151 Precalculus MATH 232 Fundamentals of Statistics	22-25	520-580	Math/Science Math/Science/Business	Four years of college-prep math
Proficient **Proficient**	MATH 104 Math for the Liberal Arts MATH 110 Linear Math & Probability MATH 115-116 Math for Elementary Teachers	17-21	400-510	Liberal Arts Majors Math/Science/Business Elementary Education Majors	Three years of college-prep math
Nearing Proficient **Basic**	MATH 100 Intermediate Algebra	15-16	360-390		Two years of college-prep math
Novice **Remedial**	MATH 001 Fundamentals of Math (Pre-Algebra) MATH 003 Beginning Algebra	< 15	< 360		Pre-high school

**See K-12 Mathematics Performance Standards*

The University of Montana-Western also uses the Beginning Algebra placement test written by the Mathematical Association of America to assist with initial placement (especially at the Novice Remedial Level).

MSU - Billings College of Technology

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	ACT		
Advanced **Advanced Level II**					Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**					Four years of college-prep math
Proficient **Proficient**	CTMA 122 College Mathematics for Tech, 3 cr.	>26 Algebra >89 Pre-Algebra	600	AAS Degree in drafting, auto tech, diesel tech, process plant tech, etc.	Three years of college-prep math
Nearing Proficient **Basic**	CTHO 112 Math Comp for Health Occupations, 3 cr.			LPN, paramedic AAS & Certificate in Business & Tech Programs	Two years of college-prep math
Novice **Remedial**	CTMA 101 Math Fundamentals, 3 cr.			Technical field Certificate Level	Pre-high school

**See K-12 Mathematics Performance Standards*

Class placement will be by a mathematics placement instrument. The ACT/SAT and high school record are used as admissions items only. The current placement test used is the ACT Compass Placement Test.

Montana College of Technology of the University of Montana - Butte

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
			Compass		
Advanced **Advanced Level II**					Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**					Four years of college-prep math
Proficient **Proficient**				Engineering Technology, Drafting	Three years of college-prep math
Nearing Proficient **Basic**	Geometry + Trigonometry, Math 103 Intermediate Algebra, Math 102 & 100	>B Avg. in HS Math	>19	Engineering Technology	Two years of college-prep math
Novice **Remedial**	Math 002	HS Grad			Pre-high school

**See K-12 Mathematics Performance Standards*

MSU - Great Falls College of Technology

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	Calculus I, Math 181, 4 cr.	>26	>610	Associate of Science (Transfer)	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	College Algebra, Math 130, 4 cr. College Trigonometry, Math 131, 3 cr.	25-26	570-600	Fire & Rescue Tech, Gen. Ed. Core (Transfer)	Four years of college-prep math
Proficient **Proficient**	Math for Liberal Arts, Math 150, 3 cr. Math for Health Science, Math 161, 4 cr. Basic Statistics, Math 216, 3 cr.	23-24	530-560	Occupational Therapy Assistant, Practical Nurse	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 108, 4 cr. Business Math, Math 104, 4 cr. Math for Elementary Teachers I, Math 120, 3 cr. Intro Algebra, Math 101, 4 cr.	21-22	490-520	Computer Tech, Allied Health, Business	Two years of college-prep math
Novice **Remedial**	Pre-Algebra, Math 065, 3 cr.	<20	200-480	Academic Skill Building, Auto Body Repair	Pre-high school

**See K-12 Mathematics Performance Standards*

All students must meet prerequisites in order to take 100 level mathematics courses at MSU - Great Falls. Prerequisites can be met with the given ACT/SAT scores or with equivalent scores on MSU - Great Falls mathematics placement test.

Helena College of Technology of The University of Montana

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	Calculus I	>26 ≥28			Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	College Trigonometry Elementary Statistics	26-27			Four years of college-prep math
Proficient **Proficient**	College Algebra	23-25		Associate of Science	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra	21-22		General Education	Two years of college-prep math
Novice **Remedial**	Fundamentals of Algebra	18-20		Accounting Tech, Computer Tech, Practical Nursing	Pre-high school

**See K-12 Mathematics Performance Standards*

Dawson Community College - Glendive

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	Calculus and Analytic Geometry, MA141, 5 cr. Calculus and Analytic Geometry, MA142, 5cr	27		Associate of Science	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Pre-Calculus, MA120, 4 cr. Elementary Statistics, MA116, 3 cr.	25	>50	Associate of Science	Four years of college-prep math
Proficient **Proficient**	Finite Math, MA105, 3 cr. College Algebra, MA103, 4 cr. Math for Elementary Teachers, MA117, 4 cr.	23	41-50	Associate of Arts	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, MA100, 3 cr.	21	34-40	Associate of Arts	Two years of college-prep math
Novice **Remedial**	Beginning Algebra, MA095, 3 cr. Pre-Algebra, LC085, 2 cr.	13-20		General Education	Pre-high school

**See K-12 Mathematics Performance Standards*

Flathead Valley Community College - Kalispell

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Tests		Concentration	High School Preparatory Courses
		Compass	ASSET		
Advanced **Advanced Level II**	Calculus I, Math 121, 5 cr.	College Alg. 57-100 Trigonometry 57-100	46-55	Associate of Science	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Trigonometry, Math 105, 3 cr. Finite Math, Math 107, 3 cr. Statistics, Math 210, 4 cr.	College Alg. 57-100	42-45	Associate of Arts, Associate of Science	Four years of college-prep math
Proficient **Proficient**	College Algebra, Math 104, 4 cr.	College Alg. 34-51	46-55 Int. 36-41 Col.	Associate of Arts, Associate of Science	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 103, 4 cr.	Algebra 64-100 or College Alg. 0-33	36-45 Int. 23-35 Col.	Associate of Applied Science, Associate of Arts, Associate of Science	Two years of college-prep math
Novice **Remedial**	Intro Algebra, Math 78, 3 cr. Arithmetic Math 10 or 108, 3 cr.	Algebra 0-37	23-40 Alg. >41	Associate of Applied Science, Associate of Arts, Associate of Science	Pre-high school
		Numerical 51-100	Num. 23-35 Num.		

**See K-12 Mathematics Performance Standards*

Miles Community College - Miles City

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels / Higher Education Levels	Courses Offered	Placement Tests		Concentration	High School Preparatory Courses
		Compass	ASSET		
Advanced **Advanced Level II**	MA 221 Calculus I, 4 cr.	Trigonometry 46-100 College Alg. 46-100		Associate of Science	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	MA 170 Survey of Calculus, 4 cr., MA 113 College Trig., 2 cr.	College Alg. 46-100		Associate of Science, Associate of Arts	Four years of college-prep math
Proficient **Proficient**	MA 103 College Algebra 4 cr. MA 105 Contemporary Math 3 cr., MA 110 Math for Elementary Teachers 3 cr. MA 201 Statistics 4 cr.	Algebra 66-100		Associate of Science, Associate of Arts, Associate of Applied Science	Three years of college-prep math
Nearing Proficient **Basic**	MA 102 Intermediate Algebra 4 cr.	Algebra 44-65		Associate of Science, Associate of Arts, Associate of Applied Science	Two years of college-prep math
Novice **Remedial**	MA 095 Beginning Algebra p/f MA 090 Pre-Algebra p/f AD 015 Math Lab	Pre-Alg. 54-100 32-53 0-31		Associate of Science Associate of Arts, Associate of Applied Science	Pre-high school

**See K-12 Mathematics Performance Standards*

Blackfeet Community College - Browning

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	Asset		
Advanced **Advanced Level II**	MAT 202 & 203, Calculus II & III, 5 cr.				Calculus
Advanced **Advanced Level I**	MAT 201, Calculus I, 5 cr.			A.S. Degrees	Pre-Calculus
Proficient **Proficient**	MAT 152, College Algebra, 5 cr. MAT 118, Finite Math, 5 cr. MAT 131 & 132, Math for Elementary Ed I & II, 5 cr. MAT 170 & 171, Statistics I & II, 3 cr.			A.S. Degrees, Business, Computer Science, General Studies-Math, Elementary Education	Algebra II
Nearing Proficient **Basic**	MAT 116, Intermediate Algebra, 5 cr. MAT 107, Technical Math, 5 cr.			A.A. Degrees, Human Services, Blackfeet Studies, AAS-(MAT 107)	Algebra I
Novice **Remedial**	MAT 104 College Prep Math I, 3 cr. MAT 105 College Prep Math II, 3 cr. MAT 106 College Prep Math III, 3 cr. MAT 115, Into to Algebra, 3 cr. MAT 100, Uses in Science, 3 cr.			None	General Math, Pre-Algebra, Algebra I

**See K-12 Mathematics Performance Standards*

Credits listed are quarter hours. 1 qtr hour = 2/3 sem hour

Chief Dull Knife College - Lame Deer

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	Asset		
Advanced **Advanced Level II**	MA 261, Applied Calculus, 3 cr.				Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	MA 252, Pre-Calculus, 3 cr. MA 152, College Trigonometry, 3 cr.				Four years of college-prep math
Proficient **Proficient**	MA 151, College Algebra, 3 cr. MA 155, Business Math, 3 cr. MA 171, Finite Math, 3 cr. MA 171 & 172, Math for Elementary Ed I & II, 3 cr. MA 250, Intro to Statistics, 3 cr.				Three years of college-prep math
Nearing Proficient **Basic**	MA 110, Intermediate Algebra, 3 cr.				Two years of college-prep math
Novice **Remedial**	MA 080, Intro to Math, 3 cr. MA 090, Intro to Algebra, 3 cr.				Pre-high school

**See K-12 Mathematics Performance Standards*

Fort Belknap College - Harlem

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	Asset		
Advanced **Advanced Level II**					
Advanced **Advanced Level I**	Statistics, 5 cr. Bio-Statistics, 5 cr.			Business Allied Health Natural Resources	
Proficient **Proficient**	College Algebra, 6 cr. Math for Elementary Education, 9 cr.			General Education Elementary Education	Algebra II
Nearing Proficient **Basic**	Intermediate Algebra, 6 cr.				Algebra I
Novice **Remedial**	Pre-Algebra, 3 cr. Intro to Algebra, 3 cr.				Basic Math

**See K-12 Mathematics Performance Standards*

Fort Peck Community College - Poplar

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	Asset		
Advanced **Advanced Level II**	Survey of Calculus, MATH 215, 3 cr.				Pre-Calculus
Advanced **Advanced Level I**	Trigonometry, MATH 130, 4 cr. Elementary Statistics, MATH 210, 3 cr.			Education, Psychology	Trigonometry
Proficient **Proficient**	College Algebra, MATH 110, 3 cr. Math for Elementary Teachers, MATH 205, 3 cr.			Core requirement, Education	Algebra II
Nearing Proficient **Basic**	Intermediate Algebra, MATH 101, 3 cr. Vocational Mathematics, MATH 105, 3 cr.			Haz/Mat/Waste Technology, Truck Drivers/Heavy Equipment, Automotive, Building Trades, Agricultural Technology	Algebra I
Novice **Remedial**	LC 060, 061, Math Lab, 1 cr. LC 085, 086, 087 College Arithmetic, 1 cr.				General Mathematics Consumer Math

**See K-12 Mathematics Performance Standards*

Little Big Horn College - Crow Agency

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		Compass	Asset		
K-12 Perf. Levels **Advanced Level II**	MA 182, Calculus II, 4 cr. MA 181, Calculus I, 4 cr.			Math Pre-engineering Computer Science	Four years that includes a strong pre-calculus course
Proficient 2 **Advanced Level I**	MA 165, Pre-Calculus, 4 cr. MA 216, Statistics, 3 cr.			Natural Resources	Four years of college-prep math
Proficient 1 **Proficient**	MA 105, College Algebra, 4 cr. MA 150, Finite Math, 4 cr.			General Studies, Crow Studies, Education, Psychology, Pre-Nursing, Business Information, Science, Systems, Human Services	Three years of college-prep math
Nearing Proficient **Basic**	MA 081, Algebra, 4 cr.				Two years of college-prep math
Novice **Remedial**	MA 061, Basic Math, 3 cr. MA 071, Pre-Calculus, 4 cr.				Pre-high school

**See K-12 Mathematics Performance Standards*

Placement will be by a mathematics placement instrument with prerequisite courses completed. Little Big Horn College currently uses an internally developed screening test in combination with student interview information, including high school records, how many years out of school, grades, attitude and other outside commitments to determine correct placement in math classes.

Salish Kootenai College - Pablo

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		TABE			
Advanced **Advanced Level II**	Calculus I, Math 110, 5 cr.			Environmental Science, General Studies Math & Science, Pre-engineering	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Pre-Calculus, Math 105, 5 cr.			Environmental Science, General Studies Math & Science, Pre-engineering	Four years of college-prep math
Proficient **Proficient**	Statistics, Math 241, 5 cr. Finite Math, Math 102, 5 cr. Math for Elementary Teachers I, Math 115, 5 cr.			General Studies Business, Elementary Education, Human Services, Nursing	Three years of college-prep math
Nearing Proficient **Basic**	College Algebra, Math 100, 5 cr.			General Education	Two years of college-prep math
Novice **Remedial**	Algebra, OSVP 099, 5 cr.				Pre-high school

**See K-12 Mathematics Performance Standards*

Stone Child College - Box Elder

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		Concentration	High School Preparatory Courses
		ACT	SAT		
Advanced **Advanced Level II**	Calculus II, Math 231, 4 cr.	>26	600	Engineering Mathematics Medical Science Computer Engineering	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	Calculus I, Math 230, 5 cr. Trig/Intro Calculus, Math 220, 3 cr.	22-25	520-580	Engineering Medical Science Computer Engineering Advanced Business Management	Four years of college-prep math
Proficient **Proficient**	College Algebra, Math 140, 3 cr. Math Liberal Arts, Math 160, 4 cr.	22-24	520-560	Allied Health Science Tech Liberal Arts Human Services Business Office Technology	Three years of college-prep math
Nearing Proficient **Basic**	Intermediate Algebra, Math 130, 3 cr.	15-21	360-520		Two years of college-prep math
Novice **Remedial**	Beginning Algebra, Fundamentals of Math, Math 090, Math 091, Math 092, Math 032, Math 033, Math 034, all 1 cr.				Pre-high school

**See K-12 Mathematics Performance Standards*

Placement will be by a mathematics placement instrument and prerequisite courses completed. The ACT/SAT and high school record is an advisory only. The current placement test used is the ACT Compass Placement Instrument.

Private colleges set their own Admissions Standards. Example:

Rocky Mountain College

Seamless Entrance Standards: College Entrance Levels and Performance Descriptions

K-12 Perf Levels* / Higher Education Levels	Courses Offered	Placement Test		College Majors	High School Preparatory Courses
		MAA Test	SAT		
Advanced **Advanced Level II**	MAT 111, Introduction Calculus I, 5 cr.	>27		Mathematics, Geology, Biology, Chemistry, Computer Science	Four years that includes a strong pre-calculus course
Advanced **Advanced Level I**	MAT 110, Elementary Functions, 3 cr., MAT 210, Probability & Statistics, 3 cr.	14-26		Biology, Aviation, Environmental Science, Business, Psychology, Sociology	Four years of college-prep math
Proficient **Proficient**	MAT 100, College Algebra, 3 cr. MAT 102, Mathematical Applications, 3 cr. MAT 103, Math for Elementary Teachers I, 3 cr. MAT 104, Math for Elementary Teachers II, 3 cr.	4-14 9-14 9-14 9-14		Core Requirements, Elementary Education	Three years of college-prep math
Nearing Proficient **Basic**	MAT 090, Refresher Math: Algebra, 0 cr.	<4			Two years of college-prep math
Novice **Remedial**	MAT 090, Refresher Math: Algebra, 0 cr.	<4			Pre-high school

**See K-12 Mathematics Performance Standards*

Self-Assessment: Sample Problems

The Office of the Commissioner of Higher Education recommends that students interested in attending one of the four-year units of the Montana University System test themselves with the sample problems that follow. If you can work these problems, you should be able to score well enough on the Mathematics portion of the ACT or SAT to satisfy the requirements for entry into Montana State University-Bozeman, Montana State University-Billings, University of Montana-Missoula, Montana State University-Northern, University of Montana-Western, and Montana-Tech of the University of Montana and to perform well in entry-level mathematics courses at these institutions.

Students should be able to solve the following problems without NEW instruction (that is, some minimal review may be offered, but the following topics should have received substantial attention in the student's background). This list is NOT intended to be exhaustive, but ALL of these topics are considered necessary for future success.

This instrument does not adequately assess communication skills. However, knowledge of the structure of the real number system and the corresponding properties of these numbers is an essential part of reading and communicating mathematics.

I. **Numbers, notation, and basic operations:**

A. Integers, Rational numbers, Real numbers

1. Find three rational numbers with different denominators between $\frac{1}{5}$ and $\frac{1}{4}$.

2. What does it mean to say that π is an irrational number?

B. Addition, subtraction, multiplication, division, exponentiation of numbers

1. Simplify (3/4)/5.

2. Change 1.69×10^{-4} to standard decimal notation.

II. Algebraic expressions and their operations:

A. Variables and substitution

1. An employee earns \$14.50 for each of the first 40 hours of a week, then \$21.50 for each hour over 40 (hours over 40 are called overtime). Write an expression for the weekly pay from the number of overtime hours worked.

2. If $x = y - 5$, write the expression $x^2 - 10x$ as an expression in y.

B. Addition, subtraction, multiplication, division, exponentiation of expressions.

1. Multiply out: $(3x - 4)(2x + 5)$.

2. Factor completely: $12x^2 - 14x - 10$.

3. Simplify: $\dfrac{3}{x} - \dfrac{3}{x - 1}$.

4. Simplify: $\dfrac{2}{1 + \dfrac{3}{x}}$.

5. Simplify: $\dfrac{(xy^3)^2}{y^2}$.

6. Let $f(x) = 2x + 1$ and $g(x) = 3x - 4$. Find and simplify $f(g(x))$.

C. Properties of Operations: Answer True or False

1. T/F $\sqrt{x^2 + 4} = x + 2$ for all positive values of x.

2. T/F $\sqrt{2x} = \sqrt{2}\ \sqrt{x}$ for all positive values of x.

3. T/F $(x + 2)^2 = x^2 + 4$ for all values of x.

4. T/F $|x| = \sqrt{x^2}$ for all values of x.

5. T/F $(a - b)^2 = a^2 - b^2$ for all values of a and b.

III. Equations and inequalities:

A. Properties of equations and inequalities.

1. Find a quadratic equation whose roots (zeros) are 2 and -1.

2. Solve $\left|\frac{x - 20}{5}\right| \geq 2$.

3. What real values of x satisfy the inequality $12 - 3x \geq 5$?

B. Solutions and interpretations

1. Solve: $x + 3(x - 5) = 2(x + 3)$.

2. Solve for p: $\frac{x^p x^2}{x^3} = x^8$.

3. Find all real solutions to: $\sqrt{2x + 1} = x - 3$.

4. An object is dropped from an initial height h (in feet) to the ground. The distance (d, in feet) from the ground at time t (in seconds) is given by $d = h - 16t^2$. How long does it take the object dropped from a 1200-foot tower to reach the ground? How far does the object fall in 3 seconds?

5. On a 100-mile trip, a car averages 40 miles per hour for the first 50 miles. How fast would it need to go for the remaining 50 miles to average 60 miles per hour overall?

IV. Coordinate systems and graphing:

A. Linear relationships, slopes and intercepts.

1. Find an equation of the line through the points (2, 5) and (6, 10).

2. Suppose a line has equation $y = 3(x - 5) + 4$. What is the slope of a line perpendicular to it?

B. Relating solutions of equations to points on a graph.

1. Give the equation of the graph with the shape of the graph of $y = x^2$, but shifted so the vertex is (3, 4) [instead of (0, 0)].

2. Suppose $x^2 + 8x = (x + b)^2 + c$ for all x. Then $b =$ _____ and $c =$ _____.

C. Simultaneous solutions of equations

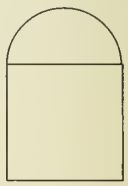
1. Solve the following system by any legitimate method: $\begin{cases} 3x - 2y = 24 \\ 5x + 6y = 12 \end{cases}$

2. Find and interpret the solution of the following system: $\begin{cases} 2x + y = 10 \\ x^2 + y^2 = 25 \end{cases}$

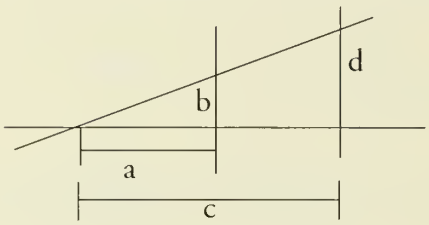
V. Geometry:

1. If the legs of a right triangle are 5 and 7, find the perimeter.

2. Find the area of the figure with a square bottom and a semi-circular top if the length of the side of the square is 8.



3. If $a = 5$ and $b = 3$ and $c = 8$, find d.



VI. Probability and Data Analysis

1. The following two-way table contains the numbers of employees that work in Marketing, Advertising, and Payroll, according to gender, at a large company.

Gender	Marketing	Advertising	Payroll
Male	35	15	3
Female	22	13	8

If one of these employees is selected at random, what is the probability that the employee is female or works in marketing?

2. Two different airlines have a flight from LA to NY that departs each weekday at a certain time. Let E be the event that the first airline's flight is fully booked on a particular day and F the event that the second airline's flight is fully booked on the same day. Suppose that $P(E)=.7$, $P(F)=.6$ and $P(E \text{ or } F)=.74$.

   What is the probability that both flights are fully booked (i.e., $P(A \text{ and } B)$) on any particular day?

3. If A and B are independent events with $P(A)=.2$ and $P(B)=.6$, what is the probability that either event A or event B occurs?

Appendix One: 1995 Board of Regents Action

Item 89-003-R1195 Approval of "Proficiency Admission Requirements and Developmental Education in the Montana University System," *November 17, 1995*

Each unit of the Montana University System will examine its current admission requirements (SAT/ACT, grade point average, and class standing) to determine if they should be increased. The Montana University System will adopt a uniform assessment tool to be used in determining if students or prospective students have the basic proficiencies in Math and English to provide them a reasonable chance of success in postsecondary education. The System will also establish the minimum level of proficiency in Math and English required for all students. Each campus of the Montana University System may establish higher levels of proficiency for any or all of its undergraduate programs. The agreed upon common assessment tool will ultimately be made available for administration to high school juniors so that they can receive an early indication of their preparedness for postsecondary education. Students would be strongly urged to take courses in their senior year of high school, which would strengthen their preparation for higher education (for example, a fourth year of high school mathematics to improve or maintain their proficiency in math). The academic officer of the Montana University System will lead an ongoing effort to determine if additional proficiencies should be added to this assessment in the future. The National Association for Developmental Education has offered the following as goals of a developmental education program:

1. Preserve and make possible educational opportunity for each postsecondary learner.
2. Develop in each learner the skills and attitudes necessary for the attainment of academic career and life goals.
3. Ensure proper placement by assessing each learner's level of preparedness for college course work.
4. Maintain academic standards by enabling learners to acquire competencies needed for success in mainstream college courses.
5. Promote the continued development and application of cognitive and affective learning theory.

Appendix Two: Answers

I. **Numbers, notation, and basic operations:**

A. Integers, Rational numbers, Real numbers
   1. Three rational numbers (e.g., 21/100, 11/50 and 6/25; if checked with calculator are between .2 and .25).
   2. It cannot be written as a quotient of integers. [or] π is not equal to m/n for any integers m and n.

B. Addition, subtraction, multiplication, division, exponentiation of numbers
   1. (3/4)/5 = 3/20
   2. 0.000169

II. **Algebraic expressions and their operations:**

A. Variables and substitution
   1. \$14.50(40) + \$21.50x, where x is the number of hours of overtime [or] 580 + 21.5x
   2. $(y - 5)^2 - 10(y - 5)$ [or] $y^2 - 20y + 75$

B. Addition, subtraction, multiplication, division, exponentiation of expressions.
   1. $6x^2 + 7x - 20$
   2. $2(3x - 5)\ (2x + 1)$
   3. $-3/\ ((x(x - 1))$
   4. $2x/\ (x + 3)$
   5. $(x^2)\ \ (y^4)$
   6. $2(3x - 4) + 1 = 6x - 7$

C. Properties of Operations: Answer True or False
   1. F
   2. T
   3. F
   4. T
   5. F

III. **Equations and inequalities:**

A. Properties of equations and inequalities.
   1. $(x - 2)\ (x + 1) = 0$ [or] $k(x - 2)\ (x + 1) = 0$ [or] $x^2 - x - 2 = 0$
   2. $x \leq 10$ [or] $x \geq 30$
   3. $x \leq 7/3$

B. Solutions and interpretations

1. $x = 21/2$ [or] $= 10.5$
2. $p = 9$
3. $x = 6.83$
4. (a) 8.66 seconds
   (b) 144 (feet)
5. 120 miles per hour

IV. Coordinate systems and graphing:

A. Linear relationships, slopes and intercepts.

1. $y - 5 = (5/4)(x - 2)$ [or] $y - 10 = (5/4)(x - 6)$ [or] $y = 1.25x + 2.5$
2. $-1/3$

B. Relating solutions of equations to points on a graph.

1. $y = (x - 3)^2 + 4$
2. $b = 4$ and $c = -16$

C. Simultaneous solutions of equations

1. $x = 6$ and $y = -3$
2. $x = 5$ and $y = 0$ [or] $x = 3$ and $y = 4$ [or] (5, 0) or (3, 4) These are the points of intersection of the circle and the line.

V. Geometry:

1. $5 + 7 + \sqrt{(5^2 + 7^2)} = 20.6$
2. $8^2 + (\pi/2)4^2 = 89.1$
3. $d = 24/5 = 4.8$

VI. Probability and Data Analysis

1. $(35 + 22 + 13 + 8)\ /96 = .8125$
2. $(.7 + .6 - .74) = .56$
3. $.2 + .6 - (.2)(.6) = .68$